



Testea
Engine Systems Inc.

AD-A267 147



GEORGE TESTEA, President

DEFENSE TECHNICAL INFORMATION CENTER (DTIC)
ATTN: SBIR
CAMERON STATION
ALEXANDRIA, VA 22304-6145

TELEPHONE: (TOLL FREE) 1-(800)-225-3842 or
COMMERCIAL 703-274-6902

April 29, 1993
DTIC
ELECTE
S A D
JUL 21 1993

It gives me great pleasure to announce my intention to establish, in Connecticut, production of my invention, "**A VERY HIGH PERFORMANCE MULTI-ROTOR COMBUSTION ENGINE**". Development and production of this engine is, I believe, in the national interest and has the potential of generating revenues in the billions of dollars both in the United States and overseas.

Testea Engine Systems and The University of Connecticut are seeking \$400,000 to develop and produce a prototype. Please review the enclosed supporting documentation:

1. Budget Plan
2. The University of Connecticut Report
3. Review Panel Evaluation Report Form
4. Correspondence from Governor Weicker

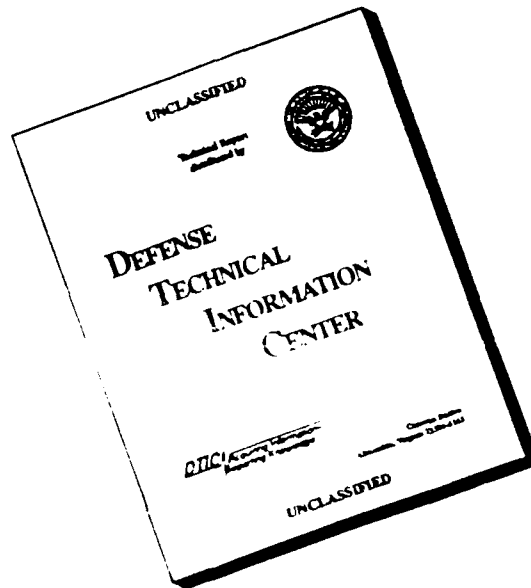
I will call next week to set up a meeting to answer any questions you may have. Time is of the essence as funding must be acquired soon to satisfy the June 1, 1993 program start date. Your attention and consideration is sincerely appreciated.

Very truly yours,

George Testea, President

This document has been approved
for public release and sale; its
distribution is unlimited

DISCLAIMER NOTICE



THIS DOCUMENT IS BEST QUALITY AVAILABLE. THE COPY FURNISHED TO DTIC CONTAINED A SIGNIFICANT NUMBER OF PAGES WHICH DO NOT REPRODUCE LEGIBLY.



Testea Engine Systems Inc.

GEORGE TESTEA, President

Governor Lowell Weicker
167 Capitol Avenue
Hartford, CT 06016

April 6, 1993

Dear Governor Weicker:

I am writing you about my intentions to found a Connecticut based engine manufacturing company. I have been told that you are in the position to make incentives and funding available for this purpose.

The major benefit I can offer the State of Connecticut is a the promise of the creation of new jobs. It is no secret that one of Connecticut's largest populations of unemployed workers is engineers and industrial manufacturers. A great number of these people would be vital resources in the success of this new company.

I wish to offer for your review some of the correspondence that I have received relating to the testing process of my engine... Among these are statistics and test results from the University of Connecticut department of Mechanical Engineering.

The production of my invention is in the national interest, and is capable of producing billions of dollars for both the United States and overseas and needs attention and consideration in this context.

Testea Engine Systems and the University of Connecticut are seeking \$400,000 to develop and produce a prototype. Please see the budget plan and report from The University of Connecticut and report review panel evaluation form.

After you review the material I have enclosed, I would greatly appreciate it if you would provide me with an updated response. I am prepared to discuss any questions you may have and provide any additional information required. I will make myself available at your convenience. I hope I have made my position clear, and that you will expedite matters to assist in securing a mutually beneficial result.

I thank you in anticipation of you attention to my proposal.

Very truly yours,

George Testea, President



LOWELL P. WEICKER JR.
GOVERNOR

STATE OF CONNECTICUT
EXECUTIVE CHAMBERS
HARTFORD, CONNECTICUT

(06106)

July 29, 1992

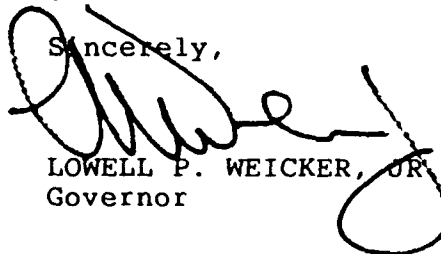
Mr. George Testea, President
Testea Engine Systems Inc.
77A Loomis Drive
West Hartford, Connecticut 06107

Dear Mr. Testea:

I would like to acknowledge and thank you for your recent letter concerning the rotary internal combustion engine you have redesigned.

I am sending your correspondence to Deputy Commissioner Robert Santy of the Department of Economic Development with my request that he arrange for Connecticut Innovations Incorporated to consider your requirements and whether any assistance can be appropriately provided at this stage.

Sincerely,



LOWELL P. WEICKER, JR.
Governor

LPW/jes

cc: Robert W. Santy, Deputy Commissioner
Department of Economic Development

Accession For	
NTIS GRA&I	✓
DTIC TAB	
Unannounced	
Justification	
By	
Date	
File	
Dist	
A-1	

93-16465



93

9



APPENDIX IV

LOWELL P. WEICKER JR.
GOVERNOR

STATE OF CONNECTICUT
EXECUTIVE CHAMBERS
HARTFORD, CONNECTICUT

August 27, 1992

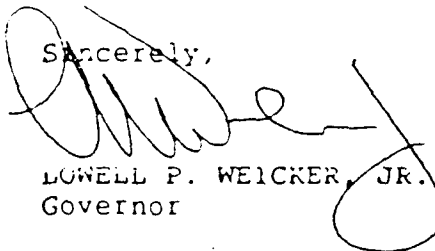
Mr. George Testea, President
Testea Engine Systems Inc.
77A Loomis Drive
West Hartford, Connecticut 06107

I would like to acknowledge your letter of August 25 and enclosures, giving me the background of your invention, which you describe as a Rotary Internal Combustion Engine.

I understand that you have been in touch with Deputy Commissioner Robert Santy of the Department of Economic Development and his associate, David Driver of Connecticut Innovations Incorporated. They indeed are the persons responsible for determining the feasibility of providing any assistance.

Accordingly, I am referring your letter to Mr. Santy for his consideration and reply to you.

Sincerely,



LOWELL P. WEICKER, JR.
Governor

LPW/JJCH/jes

cc: Robert W. Santy, Deputy Commissioner
Department of Economic Development



Business Response Center

Referral for Anthony Brescia

Priority : 2 - URGENT

Resolution Information

Call Status :

<input type="radio"/>	Open
<input type="radio"/>	Call Back
<input checked="" type="radio"/>	Closed

Date Referred: 08/28/92

Currently working with anyone on this issue?

<input checked="" type="radio"/>	Yes
<input type="radio"/>	No

If Yes, Who? Has been working with Tony
Best guess estimates for the last year for THIS LOCATION ONLY
Last yr's # empl. Unknown
Last yr's \$ sales Unknown

Call Notes and Referral Notes

sent letter to gov. and he sent it to CII, they can't resolve the problem, has talked to Tony Brescia, looking for venture capital to continue design project, had asked for one mil. but changes to 300 or 400k if he has to, He is not having any luck in getting financing. Needs space for his company and the development and manufacturing of his project, He sent his business plan and everything to CII it is moving too slow, He has spent a lot of money on the project and needs help but can't seem to get any

Terminated , called back, no further action.

Customer Information

Name: George Testea
Title:
Company Name: Testea Engine Systems Corp.
Address: 77A Loomis Drive
City, State ZIP: West Hartford, CT 06107
Phone #: 521-2132
FAX #:

Ship To Information

George Testea
Testea Engine Systems Corp
77A Loomis Drive
West Hartford, CT 06107

Call Information

Call Type: Financing
Response(s): Referral
Mat'ls Sent:
Caller Region : 2
Industry Type: Not Applicable

Referral History

Inquiry Taken: 08/27/92 09:19 AM by Sheila Leniart
Edited By: Sheila Leniart
Tracking ID: SL9208270002
Referral History:
08/27/92 09:29 43 AM - To Anthony Brescia by Sheila Leniart
08/28/92 12 32:18 PM - Closed by Sheila Leniart
08/27/92 09 27 AM by Sheila Leniart
Referral Created:
Referral Edit History:

Row	Editor	Edit Date
1	Sheila Leniart	
0	Sheila Leniart	08/27/92 09 29 56 AM

CONNECTICUT
INNOVATIONS
INCORPORATED



845 Brook Street
Rocky Hill, CT 06067-3405
Telephone (203) 258-4305
Telecopier (203) 563-4877

David C. Driver
Executive Director

March 19, 1993

Dr. Zbigniew M. Bzymek
University of Connecticut
Department of Mechanical Engineering
191 Auditorium Road
Storrs, CT 06269

Dear Dr. Bzymek:

Thank you for the submission of your project proposal 93G019, entitled "A Very High Performance Multi-rotor Combustion Engine Design and Modeling". While your project was not selected for funding under the Yankee Ingenuity Initiative grant programs, we appreciate your participation in this grant competition.

The competition this year was intense and many excellent proposals could not be funded simply because not enough money was available. One hundred twenty two proposals requesting over \$11 million were submitted to the Yankee Ingenuity Initiative. Two out-of-state experts and a panel of scientists reviewed each proposal.

Enclosed is a list of the proposals recommended for funding this year as well as the reviews of your proposal.

I encourage you to apply to the Yankee Ingenuity Initiative in the future. If you have any questions or if there is any way I might help, please do not hesitate to call.

Sincerely,

Nancy C. Rion
Director
Yankee Ingenuity Initiative

NCR/rav
Enclosures



U N I V E R S I T Y O F

CONNECTICUT

SCHOOL OF ENGINEERING
Department of Mechanical Engineering

April 2, 1993

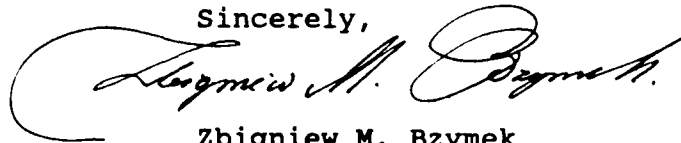
Mr. Robert N. Santy
and Mr. Anthony Brescia
Department of Economic Development
State of Connecticut
845 Brook Street
Rocky Hill, CT 06067-3405

Dear Sirs,

Responding to the request of Mr. George Testea, I am enclosing a copy of the proposal "A Very High Performance Multi-Rotor Internal Combustion Engine Design and Modeling" written for Connecticut Innovations, Inc.

The proposal was prepared by myself and Dr. Richard Garrett as a response to the referral of the Department of Economic Development to help Mr. Testea to establish research on his concept. In the Fall, 1992 competition, the Connecticut Innovations Inc. decided not to fund the proposal. Mr. Testea is asking me for further help in his development, however the University doesn't have resources to support the project. Mr. Testea told me that there could be some other ways of sponsoring the proposal. If you see such possibilities, please let me know.

Sincerely,



Zbigniew M. Bzymek
Associate Professor

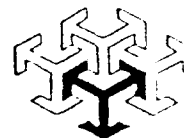
ZMB:dt

cc: Mr. George Testea
Dr. Richard Garrett
Dr. Nejat Olgac
Dr. Baki Cetegen



Proposal No. : 93G019

Yankee Ingenuity Initiative
Charles Goodyear
Cooperative Research and Development Grants
Connecticut Innovations, Inc.
Department of Economic Development



Attachment I

PROPOSAL COVER PAGE

Name and Address of Submitting Institution (including branch, campus, school or division):

Institution: University of Connecticut, Department of Mechanical Engineering

Address: 191 Auditorium Road, Storrs, CT 06269

Name and Address of Co-sponsoring Business(es):

1. Testea Engine Inc.

774 Loomis Drive, West Hartford, CT 06107

2. _____

Is the Co-sponsoring Business(es) a small business? ☒ Yes ☐ No

High Technology Field: Computer Application/ energy systems

Title of Proposed Project: "A Very High Performance Multi-rotor Internal Combustion Engine

Design & Modeling"

Amount Requested: \$172,529.-- Proposed Duration: two years Desired Starting Date: June 1, 1993

Co-sponsor Matching Funds: (1) \$186,000.- _____ (2) \$ _____

Location of Project: University of Connecticut

PI Name: Zbigniew M. Bzymek Telephone No.: (203) 486-2275

Items included in project (check where appropriate):

<input type="checkbox"/> Animal Welfare	<input type="checkbox"/> National Environmental Policy Act
<input type="checkbox"/> Endangered Species	<input type="checkbox"/> Pollution Control
<input type="checkbox"/> Human Subject	<input type="checkbox"/> Proprietary and Privileged Information
<input type="checkbox"/> Marine Mammal Protection	<input type="checkbox"/> Recombinant DNA Molecules

Principal Investigator:

Name: Zbigniew M. Bzymek

Title: PhD. Associate Professor

Signature: Zbigniew M. Bzymek Date: November 27, 1992

Authorized Institutional Representative:

Name: Thomas Tighe

Title: Provost of the University of Connecticut

Signature: Thomas Tighe Date: November 30, 1992

Authorized Co-sponsor(s) Representative(s):

1. Name: George Testea

Title: President, Testea Engine System, Inc.

Signature: George Testea Date: November 27, 1992

2. Name: _____

Title: _____

Signature: _____ Date: _____

Proposal No. : 93G019

Yankee Ingenuity Initiative
Charles Goodyear
Cooperative Research and Development Grants
Connecticut Innovations, Inc.
Department of Economic Development



Attachment II
PROJECT SUMMARY

Title of Project: "A Very High Performance Multi-rotor Internal Combustion Engine Design & Modeling"

High Technology Field: Computer Appl. / Energy Systems Amount Requested: \$168,748.-

Key Words to Describe Scientific Focus: Multi-rotor Eng., CAD, Modeling, Des. for Manufact.

Institution: University of Connecticut, Dept. of Mechanical Eng., Storrs, Connecticut, 06269

Principal Investigator(s): Z. M. Bzymek, R.E. Garrett, B. Cetegen, N. Olgac, G. Testea

Co-sponsoring Business(es) or Industry(ies): Testea Engine Systems Inc.

Technical Abstract (Limit to 200 words on this side of form):

Rapidly changing economic and market forces are causing Connecticut's manufacturing oriented firms to rely increasingly on technological innovation in order to maintain their competitive position. These firms are looking to engineering schools to help them respond to these changes. The primary task that exists, then, is a new spirit of cooperation between these firms and the University of Connecticut that would result in the formation of teams capable of developing, integrating and implementing new design and manufacturing concepts embracing up-to-date Computer-Aided Design and Computer-Aided Manufacturing technologies.

The objective of this proposal is a cooperative industry/university project between UConn's School of Engineering and Testea Engine Systems, Inc. of West Hartford, CT to research and develop a concept and design for a very high performance multi-rotor engine system of unprecedented power and economy. The high performance of the new engine is based on the utilization of a multi-rotor segment mounted on one shaft, improved combustion cylinder design and rotation under computer control. The economy will be realized through optimized fuel injection and minimizing the working rotors power.

The new system will be based on the concept proposed by Testea Engine Systems, Inc. It will be analyzed, designed and model-tested in the CAD and Expert System Laboratory at the University of Connecticut.

The proposed work will include three basic stages whose integration will make it unique. During the first stage, the concept will be studied in detail and a preliminary design will be developed. Secondly, a computer model will be created and analyzed. A simulation taking into consideration performance, safety and economy of the new engine will be generated. Thirdly, a detailed design of the system and a working model will be developed to provide the basis for prototype production. Successful completion of the three stages will place the Testea/UConn team and the State of Connecticut at the leading edge of the internal combustion engine system design, research and possibly, production.

TABLE OF CONTENTS:

1 Cover page	Page i
2 Project summary	Page ii
3 Table of contents	Page iii
4 Project description	Page 1
5 Evidence of commitment	Page 4
6 Biographical information	Page 5
7 Budget explanation	Page 13
8 Budget Statements	Page 14
9 Current pending proposals	Page 17
10 Appendices	Page 21
I Pending Patent Information from the United States Dept. of Commerce	Page 21
II Letter from the Department of Treasury, State of Connecticut (Employer Identification Number)	Page 22
III CAD&CAM Laboratory Equipment List	Page 23
IV Acknowledgement letter from the Governor, State of Connecticut	Page 24
V Statement of Matching Funds from Testea Engine Systems Inc	Page 25
VI Statement of Collaborative Intent from Testea Engine Systems Inc	Page 26

Project Description

Introduction

The first rotary engine, the Wankel Engine, was invented by the German engineer Felix Wankel in the 1920's. Between 1936 and 1945 he worked on the engine in his laboratory in Lindau in West Germany. Wankel became director of his own research establishment at Lindau, investigating the fundamental problems and applications of the rotary engine [1].

The Wankel engine is an internal combustion engine with trochoidal, rotatory piston eccentrically located in the cylinder. The working cycle of the Wankel engine is the same as in conventional engines. The first production unit was tested in 1957. Since then Mazda, a Japanese automobile company, produced and developed the Wankel engine, introducing it to the US market in 1971. During the next few years, poor fuel economy and a world oil crisis discouraged buyers, but the engine was constantly improved, and, by the end of the decade, the company's sports cars were being enthusiastically received in Europe and the United States.

Currently, the Mazda RX-7 is equipped with a 255-horsepower rotary engine with sequential twin turbochargers. It is one of the fastest sports cars in the world. 1991 Mazda cars powered with rotary engines won the 24 hour race at Le Mans. A second car produced by Mazda, the RX-792P GTP, is a race car powered by a 4-rotor engine similar to the one used in the winning Le Mans car in 1991 [2]. Though very successful in racing and sports cars, the engine is not applied in popular cars due to design and manufacturing problems.

Since the Wankel patent, several inventors patented rotary engines, but they were not superior to the Wankel engine so that, though patents were granted, the engines were seldom built. For example a rotary internal combustion engine was patented in June 1950 by the French inventor Casimir Andre Loubiere (US patent 2,511,441) [3]. On June 25, 1970 a rotary vane hydraulic motor was patented by Martti Korhonen (US patent 3,516,769) [4]. Neither engine reached a production phase.

Advantages of the Wankel engine include small overall size and mass, light weight, fewer moving parts, compactness, simple construction, low initial cost and fewer repairs. However, the Wankel Engine has several disadvantages. Serious overheating problems cause deformations of the rotor, deteriorate seals and make cooling a difficult task. The other problem is due to the elliptical two axis cylinder, which if even slightly misaligned, may cause serious vibrations.

Testea Patent Concept

The Testea System concept is a new invention patented recently. The patent includes the Turbo-Compressor and the Rotary Engine. The patent covers several group of countries: USA, Japan, European Community and others. The concept was recognized as unique and the patent is in the final stages. (Appendix 1)

The Testea System concept does not seem to have the disadvantages of the Wankel Engine. Friction is kept to a minimum, thus reducing the overheating problem. The circular rotating cylinder which holds the piston can be balanced perfectly, thereby eliminating vibrations.

The main differences and similarities of Wankel Engine and Testea System Concept are summarized below:

Wankel Engine

- Three explosions per rotation
- Elliptic cylinder
- Turbo charge or no turbo charge
- The piston is moving inside of the elliptic cylinder
- one spark plug per rotor

Testea System Concept

- Three explosions per rotation
- Round cylinder
- Turbo compressor required
- The cylinder is moving together with rotor and the two meet at the tangential point which seems to be an example of the exception to the fundamental law of gearing.
- one spark plug per rotor

The important feature of the System consists of a stationary block in which the cylinder and the rotor are mounted together

(Fig. 1). The rotor is mounted eccentrically in the cylinder. The eccentricity leaves space which becomes the combustion chamber. The cylinder rotates around an imaginary axis. The power is transmitted by the main shaft which also forms a pipe remove exhaust gases. In the simplest solution, the Turbo - Compressor is mounted on the back of the Rotor Engine (Fig. 2).

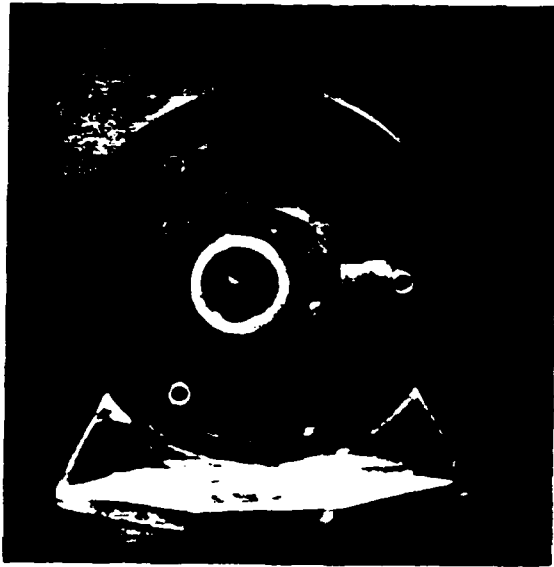


Fig. 1 Front View of the model of the Testea System



Fig. 2: The Back View of the model Testea System

Proposed Project

Objectives

The objective of this project is to model, analyze, design and build a working model of the basic configuration of the Testea System according to the patented concept. The basic configuration will consist of the Engine and Turbo Compressor as shown in the photographs of the model (Fig. 1, Fig. 2). They will be located in one block, approximately 12" high, 12" wide and 9" deep (Fig. 2). The set of preliminary drawings was prepared on a CADKEY system, but due to the page limitation, it is not included here. The drawings are available on request.

Methodology of the Research

The concept of the Testea System is a turbo charged Internal Combustion (IC) engine for motor vehicles or other applications that employ a rotary design with a stator distributor obturator. Its purpose is to provide motorists with a highly reliable engine that operates more efficiently than standard IC engines while taking up less room in the vehicle engine compartment. The Testea System would consist primarily of a motor cylinder, rotor, and stator distributor obturator. The motor cylinder would serve as the housing for the rotor and stator distributor obturator. The rotor is the mechanical part of the engine analogous to the pistons in traditional engines and also functions as

part of the distributor. It includes three obturator slots, which serve as valves through which the admission and evacuation of gases takes place. Through its motion, the rotor would force these slots to open or close in front of the stator distributor obturator. Mounted on the rotor would be three rectangular-shaped palettes positioned 120 degrees from each other.

When the rotor rotates, the palettes stay in contact with the cylinder walls, moving rectilinearly due to the centrifugal force. They serve in separating the three compartments and in creating the engine cycle (admission, compression, explosion, and evacuation). This rotor is mounted eccentrically inside the cylinder, together with the stator obturator distributor.

The stator obturator distributor consists of two pipes which are concentrically placed and fastened to the three palettes. The pipe located on the exterior is actually a pipe segment. It serves as an obturator for the rotor's slot during the explosion. Simultaneously, it forms a canal for admission with the interior pipe. The interior pipe serves to evacuate the gases towards the exterior and from compartments through which admission and evacuation occurs. The compartments are closed off at the heads by two disks, one having a concentric hole that creates the compartment through which evacuation takes place. The stator has a fixed position and the rotor rotates on it concentrically. The evacuation channel can be thermally isolated. The admission and evacuation Turbo Compressor compartments could take on different forms that best serve the function of the motor. The turbo compressor would have approximately the same elements as the motor system and would be composed of a cylinder compressor, rotor, and stator obturator distributor. The turbo compressor is not necessary for the rotating motor and a traditional version can be used and incorporated into the design.

The appealing features of the Testea System are the increased power, a distribution set that does not move, and a smaller size, as compared to most of today's engines. Instead of relying on a system of springs and moving valves within an engine block for intake and exhaust, the distribution for the Testea System remains stationary. Not only could this increase the reliability of the engine due to fewer moving mechanical components, but it would reduce engine noise and lessen the vibration normally expected from an internal combustion engine. The increased number of explosions per rotation (3) enables the vehicle to obtain more power from the engine over a wide range of speeds. Since the engine is smaller and light-weight, it takes up less space in the engine compartment. This allows vehicle designers to create aerodynamic front ends with a reduced amount of hood room required. This advantage is useful in other applications as well.

Theory

The fundamental law of Gearing and Velocity Ratio may be described as follows [5]:

$$rv = w_2/w_1 = n_2/n_1 = N_1/N_2 = d_1/d_2$$

where

- rv = velocity, rad
- w = angular velocity, rad/sec
- n = angular velocity, rpm
- N = number of teeth
- d = pitch circle diameter, in

The Testea System seems to confute this theory. One of the goals of this research is to investigate its behavior and describe exactly why it happens.

Project Milestones

The preliminary design will be done first. In this stage, we will check whether or not all the functions are satisfied.

As a next step, analysis of stress and deflection for static and dynamic loads, dynamic motion, vibration, heat transfer and materials will be done. In this stage, the computer model will be developed. After investigation of mechanical motion, stresses, deflections, vibrations, heat transfer and temperature distribution the design model will be developed using the experience of the UCONN CAD & CAM Laboratory. The Laboratory has designed three racing cars which, once built, successfully raced in significant competitions [6].

Finally the working model will be built and tested. The model should prove the feasibility of the Testea System concept. The final product of the project will be a complete design and the working model.

Special effort related to proper cooling of the engine will be required. Due to the combustion within the Testea System, an adequate cooling system would have to be incorporated into the design. If no cooling system were provided, some parts would melt from the heat of the burning fuel, and the rotor could expand so much it might seize (could not move within the main cylinder). The Testea System should be capable of withstanding these extreme conditions and remain dimensionally stable (with the use of the water jackets or some other cooling method) during normal operation.

Bibliography

- [1] "Engine Efficiency," Goodheart-Willcox Automotive Encyclopedia, 1983.
- [2] Mazda, Cars & Trucks 1993, Mazda Motor of America Inc. 1992, 7755 Irvine Center Drive, Irvine, CA 92718.
- [3] United States Patent Office, Rotary Internal-Combustion Engine, Casimir Andre Loubierre, Paris, France, No. 2,511,441; patented June 13, 1950.
- [4] United States Patent Office, Rotary Vane Hydraulic Motor, Martti Korhonen, Tasavallankatu 28, Kuopio, Finland, No. 3,516,769; patented June 23, 1970.
- [5] Deutshman A.D, Michels W.J., Wilson C. E. " Machine Design ", Theory and Practice. Macmillan Publishing Co., Inc., New York, 1975.
- [6] Bzymek Z. M., Berak J. M. et al. " Computer-Aided Design and Modeling of Car Chassis for Formula SAE " (pp.214 - 218) of UPCAEDM 90, University of Michigan, Ann Arbor 1990.

Evidence of Commitment

a. The commitment of the University of Connecticut

Both the Center for Precision Manufacturing and the Department of Mechanical Engineering are fully committed to work on the project. The research time of four faculty members, worth more than \$20,000 during the academic year and four months in summer, is clear evidence of the commitment.

b. Business

Testea Engine System Inc. is a new company founded in 1989 and registered in Connecticut on January 10, 1992 (Appendix II). It has three employees and their main goal is to develop the new engine according to the concept patented by George Testea. This project is the principal task for the company and the further existence of the company depends on its result.

c. Personnel

Personnel consist of four professors, the president of the company, technicians and administrative staff. The principal investigator Prof. Z. Bzymek will lead the team and will serve with his expertise in Inventive Design and Computer-Aided Design & Modeling, concurrent engineering and solid mechanics. Prof. Bzymek successfully lead three projects in car design. His group in mechanism design was awarded Second in a national ASME contest in 1988. Prof. R. Garrett will contribute his knowledge of computer techniques in engineering. Prof. N. Olgac will contribute

his knowledge in automatic control and Prof. Cetegen in heat transfer. .

Mr. George Testea will constantly participate in the team work. He will add his practical knowledge of combustion engines and his manufacturing expertise. The university, company technicians and equipment will give the team full capability.

d. Facilities

The CAD&CAM Laboratory is fully equipped (Appendix III) to do all the theoretical and design work. The parts for the model prototype will be machined in the Mechanical Engineering Shop and in the Precision Manufacturing Center Shop. Some parts will be delivered by Testea Engine System Inc.

Biographical Information

General characteristics of the research team

Completing the research task described in this proposal in only two years demands a very efficient and intense effort. For this reason, the research team was designed in an optimum manner. When assembling the team, knowledge, experience and the ability to work cooperatively were all taken into consideration. The research team will consist of one senior and three middle level faculty members. The team has knowledge in Inventive Design, ICAD & CAM, Automatic Control, Mechanism Design and Heat Transfer. The following are the team members:

Z. M. Bzymek - Associate Professor of Mechanical Engineering and director of CAD&CAM and Expert Systems Laboratory. Publishes in national conference proceedings and Journal of Modeling & Simulation on CAD, Modeling and Simulation. His role on the team is to generate concepts for design and supervise the design and development of the system.

R.E. Garrett - Professor of Research. Has taught design and led graduate student teams in CAD at Purdue University and the University of Connecticut. He has over ten years industrial experience in CAD and expert systems. His role on the team will focus on programming of the CAD system.

N. Olgac - Associate Professor of Mechanical Engineering. An expert on Robotics, Mechanism Design and Control. He teaches courses and leads several MS and Ph.D. theses in the area of Robotics and Automatic Control. His role on the team is to study mechanical and control problems and supervise the design of the control system.

B. Cetegen - Assistant Professor of Mechanical Engineering. Has broad knowledge in Combustion Theory and Heat Transfer. He teaches courses, leads a research team and publishes in the area of combustion and heat transfer. His role in this project is to perform the research and design of the cooling system.

Member from Testea Engine System Inc.:

George Testea - President of Testea Engine Systems Inc. His experience includes, planning and designing various mechanical products for the automotive industry, including hydraulic and pneumatic systems, and plastic injection molds, development of the manufacturing tools and devices necessary for the development of these products, research and development of mechanical systems including power distribution and lubrication systems for the manufacturing industry. He is also proficient in conceptualization, designing, and developing automated manufacturing tools and machinery and also modification of existing equipment for greater efficiency.

Biography, Bibliography and Professional Summary of ZBIGNIEW M. BZYMEK, Associate Professor
Department of Mechanical Engineering. Revised 9/92

Birth date: 8/5/35 Birthplace: Warsaw, Poland Date of Appointment: 9/81

Education B.S. 1959 Technical University of Warsaw, Poland Civil Engineering (Bridge Construction and Design)

M.S. 1961 - University of Michigan, Ann Arbor, Michigan, USA (Structural Engineering)
Ph.D. 1967 Technical University of Warsaw, Poland "The Analysis of Dynamic Deflections of Bridges Having the Deck Supported on Arches or Suspended Cables"

Experience:

1957-59 Teaching Assistant, Technical University of Warsaw, Poland
1961-63 Designer, Bridge, Road and Motortraffic Technical Equipment Design and Consulting Office "Transproject", Warsaw
1961-66 Instructor, Technical University of Warsaw, Poland
1966-72 Assistant Professor, Technical University of Warsaw, Poland
1972-81 Associate Professor, Technical University of Warsaw, Poland
1974-81 Head Editor of Serial: "Research Reports on Automatization of Structural Design", Technical University of Warsaw, Poland
1977-81 Editor in Charge of Department, Monthly "Highways" - Computer Aided Design and Bridge Construction and Design, Warsaw, Poland
1981- Associate Professor, University of Connecticut

Professional Societies: Association for Computing Machinery; International Association of Science and Technology for Development (IASTED); American Association of University Professors; American Society of Mechanical Engineers

Honors and Distinctions: Honor List Student (A-honor) in the class graduated in 1952 - Gen. Sowinski Lyceum of Warsaw, Poland

Scholarships: Honor List Scholarship in 1954-58 at the Technical University of Warsaw; United State National Student Association/Polish Student Association Graduate Exchange Scholarship, University of Michigan, Ann Arbor, Michigan (USA)

Prizes and Awards: Author of the best published review of a technical book in the year 1965, Inz i. Bud - NOT Publications, Warsaw, Poland.

Competition design of a bridge over the Vistula river in Zakroczym, First Prize Winner, 1972.
Competition design of a bridge over the Vistula in Warsaw, Winner of mention, 1974.

Award of the Secretary of the Polish Academy of Science for research in CAD of Engineering Structures, 1976.

Stefan Bryla Award of the Polish Society of Civil Engineers for advanced work in Computer Aided Design of Building Structures, 1977.

Several awards of Ministry of Higher Education in Poland for Teaching and Research Achievements in the years 1965-1979.

Member: Faculty Council of the Technical University of Warsaw (Civil Engineering) 1972-81; Advisory Council to the Mayor of the city of Warsaw (Transportation Section) 1972-81; Computer Science Committee of the Polish Academy of Science, 1976-81; Committee of Science of the Polish Association of Civil Engineers, 1968-81; Advisory Council to the Ministry of Building (Computer Application Section) 1972-1974; Pi Tau Sigma Honorary Membership since 1983; International CAD/CAM Program Committee of IASTED.

Invited Seminars: Technical University of Dresden, Dresden, G.D.R., 1972; University of Michigan 1976; Concordia

University, Montreal, Canada, 1976; Dartmouth College, Hanover, New Hampshire, 1976, Strathclyde University, Glasgow, Great Britain, 1974, 1978; Siberian Chapter of the Soviet Academy of Science, Irkutsk, 1980; University of Nagoya, Nagoya, Japan, 1980; Technical University of Darmstadt, Darmstadt, West Germany, 1980; Dartmouth College, Hanover, New Hampshire, 1981; General Motors Institute, Flint, Michigan, 1985.

Recent Grants: 1982 Stanley Works Foundation. Topic: Development of CAD/CAM in Mechanical Engineering with Peter W. McFadden. Amount: \$10,000.00
 1983 University of Connecticut Research Foundation Topic: An experiment on Synthesis of Structures Amount: \$2,600.00
 1984 Harris Foundation Topics: Energy Recovery Systems and Synthesis of Structures. Two principal investigators: P. W. McFadden and Z. M. Bzymek Amount: \$372,000.00 (Equipment Grant)
 1985 Control Data Corporation, Hamilton Standard and other sources. Topic: Computer Aided Instruction in Engineering Sciences Co-investigator cooperating with five other researchers from the School of Engineering in the project headed by Dr. Michael Cutlip Amount: \$1,200,000.00 (Equipment and graduate scholarships grant)
 1989 Equipment grant. In a group of four professors, \$80,000 in the Graduate School of the University of Connecticut.
 1989 CADKEY grant, with Peter McFadden co-investigator, Amount \$236,028.

Who's Who Listing: Listed in Marquis Who's Who Directory of Computer Graphics, First Edition, Chicago IL, USA, 1984, V. 1, pp. 41, 452, 531.

Field Specification: Computer Aided Design of Engineering Systems.

Research Interests: Engineering Design of Mechanical and Civil Systems, especially CAD/CAM; Optimization and Synthesis of Engineering Structures.

Publications: A full publication list containing over 60 items including books, textbooks, journal articles, abstracts and conference papers is available on request.

Biography, Bibliography and Professional Summary of RICHARD E. GARRETT, Professor of Research Center for Grinding Research and Development

Revised 9/92

Education: B.S. 1956 University of Delaware
 M.S. 1963 University of Florida
 Ph.D. 1967 Purdue University

Professional Positions:
 1991 - present Professor of Research (Part-time), University of Connecticut
 1989 - present Technical Consultant - Engineering Education, William C. Norris Institute
 1981 - Present Adjunct Professor, MIT
 1980 - 1990 Adjunct Professor, Purdue University
 1980 - 1989 Director of Research, CIM Division, Control Data Corporation
 1978 - 1979 Principal Consultant on CAD/CAM, Control Data Corporation
 1975 - 1978 Professor and Department Head, Mechanical Engineering, University of Connecticut, Storrs, Connecticut
 1972 - 1974 Chairman, Design Group, School of Mechanical Engineering, Purdue University, West Lafayette, Indiana
 1971 - 1975 Full Professor, Purdue University, West Lafayette, Indiana

1967 - 1971	Associate Professor, Purdue University, West Lafayette, Indiana
1964 - 1967	NASA Fellow, Ford Foundation Fellow, Purdue University
1959 - 1964	Assistant Professor, University of Florida, Gainesville, Florida
1956 - 1959	Test & Development Engineer, Hamilton Standard Division of United Technologies, Windsor Locks, Connecticut

Consultant Work:

- Control Data Corporation, Minneapolis, Minnesota
- General Electric Corporation, Schenectady, New York
- Digital Equipment Company, Maynard, Massachusetts
- Ross Gear Division of TRW, Lafayette, Indiana
- Ecological Science Corporation, Houston, Texas
- Brenner Associates, Architects, Lafayette, Indiana
- TecTran Engineering Consulting Co., Lafayette, Indiana, (President, 1971 - 1973)

Citations:

- American Men of Science, 11th Edition

Society Memberships:

Professional:	ASME	Honorary:	Omicron Delta Kappa (leadership)
	ASEE		Pi Tau Sigma (engineering)
	SESA		Sigma Xi (research)
	ACM		Scabbard & Blade (military)

Professional Activities (highlights):

- ASME Board of Research, 1983 - 1985
- ASME / National Science Foundation, Mechanical Systems Research Task Force,

1981 - 1984

- Editorial Advisory Board, Computers & Graphics International Journal, 1983 - 1985
- Editor, Journal of Intern'l Federation for Theory of Machines and Mechanisms, 1971 - 1980
- Technical Chairman, 1980 ASME Centennial on Computer Technology, San Francisco, CA
- Member, ASME Computer Technology Committee, 1977 - 1981
- NASA Workshop on Aircraft Surface Representation, NASA - AMES Research Center, 1978
- Session Chair, ASME Winter Annual Meeting, Atlanta, 1977
- Editor, Computer Graphics Section, Mechanical Engineering News, 1969 - 1975
- Associate Editor, Journal of Computer Graphics, 1973 - 1975
- Organizer of Man - Machine Interaction Group, 1st USA - JAPAN Joint Computer Conference
- Participant, 1st Computer Graphics Symposium, Uxbridge, England, 1970
- Co-Editor, Kinesiology Review, 1969 - 1972
- Chairman, ASEE Engineering Design Committee, 1969 - 1970
- Lecturer, Short Course on Modern Design Engineering, for Engineers of Ingersoll-Rand, 1969

Research

Current research directed toward the goal of increasing the effective use of computing equipment in the science and engineering areas in general, and in particular, mechanical design, manufacturing, optimization and visualization (graphics). Recently directed the engineering research activities for Control Data Corporation at MIT, Purdue, Stanford, Connecticut and an MIT spinoff project on engineering constraint management at the University of Puerto Rico. Presently consulting for the engineering programs for the William C. Norris Institute - a non-profit organization; involved in research in grinding at the University of Connecticut; and assisting with organizing an industrial consortium at MIT.

Committees

- Engineering Advisory Committee, University of Connecticut, 1986 - 1991
- Research Council, University of Connecticut, 1976 - 1979
- Executive Committee, Research Council, University of Connecticut, 1977 - 1978
- University Senator (Alternate), Purdue University, 1975
- Mechanical Engineering Head Selection Committee, Purdue University 1974 - 1975
- Chairman, Ad-Hoc Research Committee, Purdue University, 1974 - 1975
- Graduate Committee, Purdue University, 1971 - 1975

Special Appointment:

- Appointed by Secretary of the Air Force to study the U.S. Air Force's capabilities in Computer Graphics at their various research installations around the country, 1974

Research Grants and Financial Support:

• NASA - AMES Research Center	179,000	1973 - 1976
• NASA - AMES Research Center (joint Purdue Univ / Univ of Connecticut grant)	140,000	1977 - 1978
• NASA - AMES Research Center (joint Purdue Univ / Univ of Connecticut grant)	140,000	1979 - 1980
• Control Data Corporation (CIM Division grants to Purdue - approx.)	4,000,000	1980 - 1989
• Control Data Corporation (CIM Division grants to MIT - approx.)	2,500,000	1981 - 1989

Recent Refereed Publications:

- "Computer Graphic Design Tools: A Systematic Approach to Computer Education", M.A. Gunn, R.E. Garrett, Proceedings of 2nd World Conference on Computers in Education, Marseilles, France, September 1975.
- "Computer Graphics: The Evolution of a Creative Engineering Environment", D.C. Anderson, R.E. Garrett, Proceedings of NASA Conference on Applications of Computer Graphics in Engineering, NASA Langley Research Center, Hampton, Virginia, October 1975.
- "A Generalized Interactive Three Dimensional Input System", P.R. White, R.E. Garrett, Journal of Computer Aided Design, 2nd International Conference on Computer Aided Design, London, England, March 1976.
- "A System for Computer Generated Display of Three Dimensional Designs", P.R. White, R.E. Garrett, ASME Paper No. 77 - DE - 31, ASME Design Engineering Conference, Chicago, May 1977.
- "A Hierarchal Data Organization Facilitating Interactive Three Dimensional Design", P.R. White, R.E. Garrett, ASME Paper No. 77 - DET - 108, ASME Design Engineering Technical Conference, Chicago, September 1977.
- "Three Dimensional Energy Analysis Via Interactive Computer Graphics", D.R. Riley, R.E. Garrett, G.E. Garrett, Biomechanics, International Series on Biomechanics, Vol. 2A, University Park Press, Baltimore, 1978.
- "Surface Anthropometry and the Kinematics of Growth", G.E. Garrett, R.E. Garrett, J.A. Brewer, Biomechanics, Vol. 2A, University Park Press, Baltimore, 1978.
- "Mathematical Techniques for Surface Description", S.M. Staley, R.E. Garrett, Proceedings of NASA - AMES Conference on Aircraft Surface Representation for Aerodynamic Computation, March 1978.
- "Three Dimensional Human Motion: Analysis and Simulation via Computer Graphics", D.R. Riley, R.E. Garrett, G.E. Garrett, Chapter in Science in Biomechanics Cinematography, Academic Publishers, Del Mar, California, 1979.
- "Establishing a Computerized Biomechanical Atlas of Infant Motor Patterns", G.E. Garrett, R.E. Garrett, Biomechanics VII, University Park Press, Baltimore, 1980.
- "Research Needs in Mechanical Systems", K.N. Reid, R. Cohen, R.E. Garrett, H.H. Richardson, W.O. Winer, Select Panel on Research Goals and Priorities for the National Science Foundation, NSF

Grant MEA 81 - 19616, Mechanical Engineering, Vol. 106, No. 3, March 1984.

Nejat Olgac, Associate Professor, Department of Mechanical Engineering.

Date of birth: Aug. 28, 1950

Education: 1976: Dr. Eng. Sci. - Columbia University "Stochastic Optimal Control Problems Related to Artificial River Aeration Systems"
1972: M.S. - Technical University of Istanbul, Turkey Mechanical Engineering
1972: B.S. - Technical University of Istanbul, Turkey Mechanical Engineering

Experience: 4/89-6/89: DAAD Study-Visit Scholar, Technical Univ. of Munich, W. Germany.
9/88-4/89: Invited Professor, French Research Institute on Computer Science and Automation (INRIA), Sophia Antipolis, France.
88-present: Associate Professor, Department of Mechanical Engineering, University of Connecticut, Storrs.
9/81-9/88: Assistant Professor, Department of Mechanical Engineering, University of Connecticut, Storrs.
9/76-8/81: Asst. Gn. Mgt., Transturk Holding Group, Istanbul, Turkey. Elektroakustik, S.A., a Transturk subsidiary and manufacturer of TV sets and radios.
1973-76: New York Institute of Technology, Adjunct Assistant Professor.
Active: Industrial consulting on system dynamics, general engineering projects.

Recent Publications:

- * Sliding Mode Control with Perturbation Estimation (SMCPE) a New Approach, (H.Elmalı, N.Olgac), International J. of Control, vol.56, no.4, 1992.
- * Robust Output Tracking Control of Nonlinear MIMO Systems via Sliding Mode Technique (H.Elmalı, N.Olgac), Automatica, vol.28, no.1, 1992.
- * Theory and Implementation of Sliding Mode Control with Perturbation Estimation, (H.Elmalı, N.Olgac), IEEE Robotics and Automation Conference, Nice, 1992.
- * Position Feedback-Induced Resonance: Delayed Resonator, (N.Olgac, M.McFarland, B.Holm-Hanson), ASME, DSC-vol.38, WAM 1992.
- * A Novel Robust Control Strategy for Nonlinear Systems with Variable Structure, (N.Olgac, H.Elmalı), 8th IFToMM Conference in Prague, 1991.
- * Sliding Mode Control of Remotely Operated Vehicles for Horizontal Plane Motions, (N.Olgac, B.E.Plattin, J.Chang), IEEE Control Theory and Applications, D-vol.138, no.5, 1991.
- * On the Dynamics of Metal Cutting with Nonlinearities and Time Delays, (N.Olgac, J.Chang), Int. J. of Modeling and Simulation, vol.11, no.2, 1990.
- * An Application of Variable Structure Systems with Sliding Mode Control to a Remotely Operated Vehicle, (B.Plattin, J.Chang, N.Olgac) 11th IFAC World Congress, Tallinn, USSR, Aug. 1990.

Recent Research grants and projects:

- * "Design of Precision Electric Motor Drive Controllers", a part of the precision manufacturing initiative (PMI), through the CT Dept. of Economic Development (1991-94), \$225,000.
- * "Experimental Study for the Sliding Mode Control on Robot Drives" An equipment grant from the State of Connecticut (1991), \$30,000.
- * "Dual Robot-Vision Guided Welding Operations" ((1987-89). Grant by Department of Higher Education and United Technologies Research Center, \$120,000.
- * A program on "Development of on-line vibration detection and feedback control of surface quality for metal cutting processes", NSF, SME, UCONN Research Foundation (1983-86), total of \$60,000.

**Biography, Bibliography and Professional Summary of Baki M. Cetegen, Assistant Professor,
Department of Mechanical Engineering, The University of Connecticut, Storrs.**

Education:

B.S. in Mechanical Engineering: Bogazici University, Istanbul, Turkey, June 1978.
Minors in Physics and Thermal Sciences.

M.S. in Mechanical Engineering: University of California, Berkeley, Nov. 1979.
Thesis: Study of Performance of a Plasma Jet Igniter.

Ph.D. in Mechanical Engineering: California Institute of Technology, June 1982
Thesis: Entrainment and Flame Geometry of Fire Plumes.

Professional Employment:

9/1987 - Present Assistant Professor of Mechanical Engineering, University of Connecticut,
Storrs, also Adjunct Assistant Professor of Chemical Engineering.

9/1986 - 9/1987 Research Fellow, University of California, Irvine.

5/1984 - 9/1986 Group Leader, Energy and Environmental Research Corporation, Irvine,
California.

9/1982 - 4/1984 Research Engineer, Energy and Environmental Research
Corporation, Irvine, California.

6/1982 - 8/1982 Research Fellow, California Institute of Technology, Pasadena, California.

Awards and Honors:

California Institute of Technology, Tuition Fellowships and Research Assistantship, 1982, 1981, 1980. University of California, Berkeley, Tuition Fellowship, Teaching and Research Assistantship, 1978-1979. Valedictorian of the 1978 Engineering Graduating Class at Bogazici University, Istanbul, Turkey. Connecticut Space Grant Consortium Summer Fellowship, 1982.

Publications: Recent Refereed Articles

Cetegen, B.M. and Sirignano, W.A., "Study of Molecular Mixing and a Finite Rate Chemical Reaction in a Mixing Layer", Twenty-Second Symposium (International) on Combustion, pp. 489-494 (1988).

Cetegen, B.M. and Sirignano, W.A., "Study of Mixing and Reaction in the Field of Vortex", Combustion Science and Technology, vol. 72, pp. 157-181 (1990)

Cetegen, B.M. and Aguirre, J.P., "Analysis of Molecular Mixing and Chemical Reaction in a Vortex Pair", Physics of Fluids A, 2(12), December 1990.

Cetegen, B.M. and Bogue, D.R., "Combustion in a Stretched Fuel Strip with Finite Rate Chemistry", Combustion and Flame, 86: 359-370, 1991.

Cetegen, B.M. and Pines, D.S., "Combustion of a Stretched Carbon Monoxide Ligament with Radiative Heat Losses", accepted for publication in Combustion and Flame, 91: 143-152, 1992.

Ghoniem, A.F., Soteriou, M.C., Knio, O.M., and Cetegen, B.M., "Effect of Steady and Periodic Strain on Unsteady Flamelet Combustion", to appear in the proceedings of the Twenty-Fourth Symposium (International) on Combustion, The Combustion Institute (1992)

Cetegen, B.M. and Mohammed, N., "Experiments on Liquid Mixing and Reaction in a Vortex", to appear in Journal of Fluid Mechanics, Associate Editor: Sidney Leibovich, Cornell University.

Cetegen, B.M. and Ahmed, T., "Experiments on the Periodic Instability of Buoyant Plumes and Pool Fires", accepted for publication in Combustion and Flame, Editor: Gerald Faeth, 1992.

Recent Conference Proceedings and Meeting Presentations:

Cetegen, B.M. and Mohammed, N., "Experiments on Liquid Mixing and Reaction in an Isolated 2D Vortex", Presented at the Combustion Institute Eastern States Meeting, Orlando, FL., November 1990.

Cetegen, B.M., and Ahmed, T., "Experimental Study of Puffing Behavior in Pool Fires", Presented at the Combustion Institute Eastern States Meeting, Orlando, FL., November 1990.

Pines, D.S. and Cetegen, B.M., "CO Oxidation in a Time-dependently Stretched Fuel Strip with Radiative Heat Losses", presented at the Combustion Institute Eastern States Meeting, Cornell University, Ithaca, N.Y., October 1991.

Mohammed, N. and Cetegen, B.M., "Experiments on Molecular Mixing in the Field of a Vortex", presented at the Combustion Institute Eastern States Meeting, Cornell University, Ithaca, N.Y., October 1991.

Foster, S.G., Tageldin, M. and Cetegen, B.M., "Dispersion and Evaporation of Liquid droplets in a turbulent, Planar Mixing layer", presented at the Combustion Institute Eastern States Meeting, Cornell University, Ithaca, N.Y., October 1991.

Mohammed, N. and Cetegen, B.M., "Experiments on High Schmidt Number Mixing in an Isolated Two Dimensional Vortex", presented at the Annual Meeting of the American Institute of Chemical Engineering, November 20, 1991, Los Angeles CA

Soteriou, M.C., Knio, O.M., Ghoniem, A.F. and Cetegen, B.M., "Simulations of Flow-Combustion Interactions in a Spatially Developing Mixing Layer", AIAA 30th Aerospace Sciences Meeting, Paper no:92-0081, Reno NV, January 1992.

Biography, Bibliography and Professional Summary of GEORGE TESTEA, President, Testea Engine Systems; revised 11/92

Birth date. August 19, 1934, Recea, Brasov, Romania

Education. M.S. Polytechnic Institute - Brasov, Romania

Experience: Mechanical Design Engineer at Automatica, Bucharest Romania. 1959-63
Mechanical Design Engineer at Institute for Research of Machine Construction Technology, Bucharest Romania 1963-68
Manager, Cooperative Company, Bucharest Romania. 1968-83

Budget

a Budget detail (see Attachment III, pages 17,18,19)

b. Budget Explanation

The project will last two years. In the first year, the main cost of \$52,380 will consist mainly of personnel salaries and wages. A \$2500.00 amount for travel is connected with gathering materials, participating in the related conferences and travel between Storrs and West Hartford where the company office is located. Materials and supplies, books, manuals etc. (cost \$2500.00) are necessary for modeling of the system and other expenses connected with the project. Shop services are also needed for the model preparation.

In the second year, the structure of the expenses is similar, however, the wages of technicians and costs of the shop services are higher. This is connected with work on physical model.

Current and Pending Support (see Attachment IV, pp. 20,21,22,23)

Collaborative Policies

University Collaborative Policy Statement is attached. This policy statement supersedes any other reference to collaborative policies.

Special Consideration

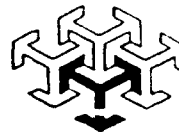
George Testea was directed to the University of Connecticut by the Department of Economics of the State of Connecticut after he received a letter from Governor Lowell P. Weicker Jr. referring him to the Commissioner, Robert Santy (Appendix IV). The task which the project team is taking is to design, model and study the concept of the engine. This project is undertaken by the university in understanding of the Governor's program for helping small businesses. The concepts seem to be promising and if the company finds a serious investor, it can become very successful. The Testea System invention is an excellent opportunity for the Yankee Ingenuity Initiative.

Testea Engines Inc. agreed to sponsor this proposal by contributing \$186,000 (Appendix V) and endorsing the statement of collaborative intent. (Appendix VI).

Proposal No. : **93G019**

**Yankee Ingenuity Initiative
Charles Goodyear
Cooperative Research and Development Grants**

**Connecticut Innovations, Inc.
Department of Economic Development**



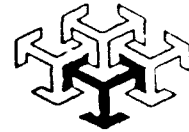
**Attachment III
SUMMARY PROPOSAL BUDGET
(REFER TO SECTION I FOR ALLOWABLE COSTS)**

First year: June 1, 1993 May 31, 1994

ORGANIZATION <i>University of Conn., Dept. of Mechanical Engr.</i>		AWARD NO.			FOR DHE USE ONLY	
					DURATION (MONTHS)	
					PROPOSED	GRANTED
PRINCIPAL INVESTIGATOR <i>Zbigniew M. Bzymek</i>		AWARD NO.				
A.	SENIOR PERSONNEL: PI, Co-PIs, Faculty and Other Senior Associates (list each separately with title and organization, A 6: Show number in brackets)	DHE FUNDED PERSON-MOS			FUNDS REQUESTED FROM DHE	FUNDS CONTRIBUTED BY CO-SPONSOR(S)
		CAL	ACAD	SUMR		
	1 <i>Richard E. Garrett-Professor</i>				7,000.	
	2 <i>Zbigniew M. Bzymek-Associate Professor</i>			1.50	10,000.	
	3 <i>Nejat Olgac - Associate Professor</i>			1.00	6,500.	
	4 <i>Baki Cetegen - Assistant Professor</i>			1.00	5,800.	
	5 () TOTAL SENIOR PERSONNEL (1-4)				29,300.	
B.	OTHER PERSONNEL (SHOW NUMBER IN BRACKETS)					
	1 () POST DOCTORAL ASSOCIATES					
	2 () OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)					12,000.
	3 (2) GRADUATE STUDENTS		2		22,084.	
	4 () UNDERGRADUATE STUDENTS				2,500.	
	5 () SECRETARIAL-CLERICAL					
	6 () OTHER - SPECIFY <i>Specialist 1x12x2000</i>					24,000.
	TOTAL SALARIES & WAGES (A & B)				53,884.	36,000.
C.	FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				5,877.	5,640.
	TOTAL SALARIES, WAGES & FRINGE BENEFITS (A+B+C)				59,761.	41,640.
D.	PERMANENT EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH EXCEEDING \$500)					
E.	TRAVEL: DOMESTIC (SPECIFY ON BUDGET EXPLANATION PAGE)				2,500.	2,000.
F.	OTHER DIRECT COSTS					
	1 MATERIAL AND SUPPLIES <i>also- books, manuals</i>				3,356.	5,000.
	2 PUBLICATION COSTS/PAGE CHARGES					
	3 COMPUTER (ADPE) SERVICES					
	4 OTHER <i>shop services</i>				2,000.	
	TOTAL OTHER DIRECT COSTS				5,356.	
	TOTAL DIRECT COSTS (A THROUGH F)				67,617.	48,640.
	INDIRECT COSTS (SPECIFY ON BUDGET EXPLANATION PAGE) 22%				14,876.	10,700.80
	TOTAL DIRECT AND INDIRECT COSTS (G+H)				82,493.	59,340.80

Proposal No. **93G019**

Yankee Ingenuity Initiative
Charles Goodyear
Cooperative Research and Development Grants
Connecticut Innovations, Inc.
Department of Economic Development



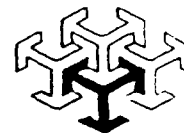
Attachment III
SUMMARY PROPOSAL BUDGET
(REFER TO SECTION I FOR ALLOWABLE COSTS)

Second year: June 1, 1994- May 31, 1995

ORGANIZATION <i>University of Conn., Dept. of Mechanical Engr.</i>		AWARD NO.		FOR DHE SE ONLY DURATION (MONTHS) PROPOSED GRANTED	
PRINCIPAL INVESTIGATOR <i>Zbigniew M. Bzymek</i>		AWARD NO.			
A	SENIOR PERSONNEL: PI, Co-PTs, Faculty and Other Senior Associates (list each separately with title and organization, A 6: Show number in brackets)	DHE FUNDED PERSON-MOS		FUNDS REQUESTED FROM DHE	FUNDS CONTRIBUTED BY CO-SPONSOR(S)
		CAL	ACAD.	SUMR.	
	1 <i>Richard E. Garrett-Professor</i>				7,500.
	2 <i>Zbigniew M. Bzymek-Associate Professor</i>			1.50	10,700.
	3 <i>Nejat Olgac - Associate Professor</i>			1.00	7,000.
	4 <i>Baki Cetegen - Assistant Professor</i>			1.00	6,300.
	5 () TOTAL SENIOR PERSONNEL (1-4)				31,500.
B	OTHER PERSONNEL (SHOW NUMBER IN BRACKETS)				
	1 () POST DOCTORAL ASSOCIATES				
	2 () OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)				13,080.
	3 (2) GRADUATE STUDENTS		2		23,630.
	4 () UNDERGRADUATE STUDENTS				2,750.
	5 () SECRETARIAL-CLERICAL				
	6 () OTHER - SPECIFY <i>Specialist 12 x 1030</i>				13,080.
	TOTAL SALARIES & WAGES (A & B)				57,880.
C	FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				7,167.
	TOTAL SALARIES, WAGES & FRINGE BENEFITS (A+B+C)				65,047.
D	PERMANENT EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH EXCEEDING \$500.)				
E	TRAVEL - DOMESTIC (SPECIFY ON BUDGET EXPLANATION PAGE)				2,500.
F	OTHER DIRECT COSTS				
	1 MATERIAL AND SUPPLIES <i>books, manuals</i>				1,753.
	2 PUBLICATION COSTS/PAGE CHARGES				1,500.
	3 COMPUTER (ADPE) SERVICES				63,603.
	4 OTHER <i>maintenance</i>				3,000.
	TOTAL OTHER DIRECT COSTS				6,253.
G	TOTAL DIRECT COSTS (A THROUGH F)				73,800.
	INDIRECT COSTS (SPECIFY ON BUDGET EXPLANATION PAGE) 22%				16,236
	TOTAL DIRECT AND INDIRECT COSTS (G+H)				90,036
					126,659.20

Proposal No. : 93G019

Yankee Ingenuity Initiative
Charles Goodyear
Cooperative Research and Development Grants
Connecticut Innovations, Inc.
Department of Economic Development



Attachment III
SUMMARY PROPOSAL BUDGET
(REFER TO SECTION I FOR ALLOWABLE COSTS)

Cumulative: June 1, 1993-May 31, 1995

ORGANIZATION <i>University of Conn., Dept. of Mechanical Engr.</i>		AWARD NO.			FOR DHE USE ONLY	
					DURATION (MONTHS)	
					PROPOSED	GRANTED
PRINCIPAL INVESTIGATOR <i>Zbigniew M. Bzymek</i>						
A	SENIOR PERSONNEL: PI, Co-PI's, Faculty and Other Senior Associates (list each separately with title and organization, A.6: Show number in brackets)	DHE FUNDED PERSON-MOS			FUNDS REQUESTED FROM DHE	FUNDS CONTRIBUTED BY CO-SPONSOR(S)
		CAL.	ACAD.	SUMR.		
	1 <i>Richard E. Garrett-Professor</i>				14,500.	
	2 <i>Zbigniew M. Bzymek-Associate Professor</i>			3.0	20,700.	
	3 <i>Nejat Olgac - Associate Professor</i>			2.0	13,500.	
	4 <i>Baki Cetegen - Assistant Professor</i>			2.0	12,100.	
	5 () TOTAL SENIOR PERSONNEL (1-4)				60,800.	
B	OTHER PERSONNEL (SHOW NUMBER IN BRACKETS)					
	1 () POST DOCTORAL ASSOCIATES <i>Tech. & Prog.</i>					
	2 () OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC)					25,080.
	3 () 2 () GRADUATE STUDENTS		2		45,714.	
	4 () UNDERGRADUATE STUDENTS				5,250.	
	5 () SECRETARIAL-CLERICAL					
	6 () OTHER - SPECIFY					37,080.
	TOTAL SALARIES & WAGES (A & B)				111,764.	62,160.
C	FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS) <i>11%</i>				13,045.	8,518.
	TOTAL SALARIES, WAGES & FRINGE BENEFITS (A+B+C)				124,809.	70,678.
D	PERMANENT EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH EXCEEDING \$500)					
E	TRAVEL: DOMESTIC (SPECIFY ON BUDGET EXPLANATION PAGE)				5,000.	4,000.
F	OTHER DIRECT COSTS					
	1 MATERIAL AND SUPPLIES				5,109.	10,792.
	2 PUBLICATION COSTS/PAGE CHARGES				1,500.	
	3 COMPUTER (ADPE) SERVICES					63,603.
	4 OTHER <i>shop services</i>				5,000.	
	TOTAL OTHER DIRECT COSTS				11,609.	
G	TOTAL DIRECT COSTS (A THROUGH F)				141,418.	149,073.
H	INDIRECT COSTS (SPECIFY ON BUDGET EXPLANATION PAGE) <i>22%</i>				31,112.	32,796.06
	TOTAL DIRECT AND INDIRECT COSTS (G+H)				172,529.	186,000.

Attachment IV
SUMMARY OF ALL CURRENT AND PENDING RESEARCH SUPPORT (FROM WHATEVER SOURCE)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of the proposal.

Name of Investigator: <i>Richard E. Garrett</i>	A Source of Support 1.	B Project Title 2.	C Award Amount \$	D Period Covered by Award	E Person-Months or % of effort Committed to the project 3		F Location where research is/will be performed
					ACADEMIC YEAR	SUMMER	
I. Current Support List. If none, report none.	1.	<i>Dept. of Ec. Devel.</i>	<i>*1) 75,000</i>	<i>9/91-8/93</i>			<i>University of Connecticut</i>
	2.						
	3.						
II. Proposal Pending List: A. This proposal B. Other pending proposals & renewals C. Proposals planned to be submitted in near future.	A1.	<i>Dept. of Ec. Devel.</i>	<i>*4) 99,500</i>	<i>5/93-5/94</i>	<i>10%</i>	<i>10%</i>	<i>University of Connecticut</i>
	B2.						
	B3.						
	C4.	<i>no plans yet</i>					
	C5.						
III. Prior Support for this Project If this project has previously been funded.	1.	<i>none</i>					
	2.						
IV. Other agencies to which this proposal has been/will be submitted.	1.	<i>none</i>					
	2.						
	3.						

1. Include Federal and Other State Agencies, and private resources
2. Entry to project title should be number coding (i.e., 1, 2, ...) and the full titles should be identified according to number on an attached sheet (i.e., 1. full title, 2. full title ...)
3. Non-academic researchers may report percentage of total research effort using the first column only.

USE ADDITIONAL SHEETS AS NECESSARY

Attachment IV

SUMMARY OF ALL CURRENT AND PENDING RESEARCH SUPPORT (FROM WHATEVER SOURCE)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of the proposal.

Name of Investigator: <i>Zbigniew M. Bzymek</i>	A Source of Support 1.	B Project Title 2.	C Award Amount \$	D Period Covered by Award	E Person-Months or % of effort Committed to the project. 3		F Location where research is/will be performed
					ACADEMIC YEAR	SUMMER	
I. <u>Current Support</u> List. If none, report none.	1. <i>Dept. of Ec. Devel.</i>	*1)	75,000.- +236,028.	3/91-7/93	10%	20%	<i>University of Connecticut</i>
	2. <i>Harris Foundation</i>	*2)	374,067.	1985-92	5%	1%	<i>University of Connecticut</i>
	3. <i>Harris Comp. Systems</i>	*3)	571,200	1992 -	5%	5%	<i>University of Connecticut</i>
II. <u>Proposal Pending</u> List: A. This proposal B. Other pending proposals & renewals C. Proposals planned to be submitted in near future.	A1. <i>Dept. of Ec. Devel</i>	*6)	47,262.	6/93-5/94	10%	10%	<i>University of Connecticut</i>
	B2. <i>Silicon Graphics</i>	*5)	189,529	92-95	5%	5%	<i>University of Connecticut</i>
	B3.						
	C4. <i>Dept. of Ec. Devel.</i>	*4)	99,500.-	6/93-5/94	10%	10%	<i>University of Connecticut</i>
	C5.						
III. <u>Prior Support for this Project</u> If this project has previously been funded.	1. <i>none</i>	*1) <i>Development of Intelligent Computer-Aided Engineering Module</i> *2) <i>Computer-Aided Design and Graphics Hardware and Software Grant</i>					
	2.	*3) <i>Computer - Aided Design Software + Hardware Grant.</i>					
IV. <u>Other agencies to which this proposal has been/will be submitted.</u>	1. <i>none</i>	*4) <i>Equipment proposal</i> *5) <i>Maintenance and Industry Training in Visual Modeling</i>					
	2.	*6) <i>Improved Stereolithography modeling of machine parts for precision manufacturing</i>					
	3.						

1. Include Federal and Other State Agencies, and private resources
2. Entry to project title should be number coding (i.e., 1, 2, ...) and the full titles should be identified according to number on an attached sheet (i.e. 1. full title, 2. full title ...)
3. Non-academic researchers may report percentage of total research effort using the first column only.

USE ADDITIONAL SHEETS AS NECESSARY

Attachment IV
SUMMARY OF ALL CURRENT AND PENDING RESEARCH SUPPORT (FROM WHATEVER SOURCE)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of the proposal.

Name of Investigator: <i>Nejat Olgac</i>	A Source of Support 1.	B Project Title 2.	C Award Amount \$	D Period Covered by Award	E Person-Months or % of effort Committed to the project 3		F Location where research is/will be performed
					ACADEMIC YEAR	SUMMER	
I. Current Support List. If none, report none.	1.	<i>Dept. of Eco. Devel.</i>	<i>*1) 225,000</i>	<i>91 - 94</i>	<i>30 %</i>	<i>-</i>	<i>University of Connecticut</i>
	2.	<i>Conn. Inno. Inc. (PMI)</i>	<i>*2) 30,000</i>	<i>6/92 - 6/93</i>	<i>10%</i>	<i>-</i>	<i>University of Connecticut</i>
	3.						
II. Proposal Pending List: A. This proposal B. Other pending proposals & renewals C. Proposals planned to be submitted in near future.	A1.	<i>Dept. of Ec. Devel.</i>	<i>*4) 172,529.</i>	<i>9/93-8/95</i>	<i>5%</i>	<i>1 month</i>	<i>University of Connecticut</i>
	B2.	<i>Uconn. Res. Found.</i>	<i>*3) 14,331</i>	<i>1/93 - 12/93</i>	<i>10%</i>		<i>University of Connecticut</i>
	B3.	<i>DED/CII</i>	<i>*5) 138,269</i>	<i>6/93-6/95</i>	<i>20%</i>		<i>University of Connecticut</i>
	C4.	<i>DED/CII</i>	<i>*6) 51,000</i>	<i>6/93 - 6/94</i>	<i>5%</i>		<i>University of Connecticut</i>
	C5.	<i>NSF</i>	<i>*7) 140,000</i>	<i>6/93 - 6/95</i>	<i>25%</i>	<i>2month</i>	<i>University of Connecticut</i>
III. Prior Support for this Project If this project has previously been funded.	1.	<i>*1) Design of Precision Electric Motor Drive Controllers</i>					
	2.	<i>*2) Robust Dynamic Motion Control for High Speed Milling Processes</i>					
IV. Other agencies to which this proposal has been/will be submitted.	1.	<i>*3) A New Method for Tunable Vibration Absorption: the Delayed Resonator</i>					
	2.	<i>*4) A Very High Performance Multi-Rotor Internal Combustion Engine (Design & Modeling)</i>					
	3.	<i>*5) A New Control Strategy for the Oscillatory Dynamics: Position Feedback with delay</i>					
		<i>*6) Experimental Verification and Evaluation of New Motion Control Algorithms</i>					
		<i>*7) A New Concept for Active Vibration Absorption: Delayed Resonators</i>					

1. Include Federal and Other State Agencies, and private resources
2. Entry to project title should be number coding (i.e., 1, 2, ...) and the full titles should be identified according to number on an attached sheet (i.e., 1. full title, 2. full title ...)
3. Non-academic researchers may report percentage of total research effort using the first column only.

USE ADDITIONAL SHEETS AS NECESSARY

Attachment IV
SUMMARY OF ALL CURRENT AND PENDING RESEARCH SUPPORT (FROM WHATEVER SOURCE)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of the proposal.

Name of Investigator:	A	B	C	D	E		F
					Person-Months or % of effort Committed to the project. 3		
	Source of Support 1.	Project Title 2.	Award Amount \$	Period Covered by Award	ACADEMIC YEAR	SUMMER	Location where research is/will be performed
I. Current Support List. If none, report none.	1. DED	*1)	33,500	6/91 - 6/92	10%	0.5 month	University of Connecticut
	2.	*2)					
	3.	*3)					
II. Proposal Pending List: A. This proposal B. Other pending C. Proposals & renewals proposals planned to be submitted in near future.	A1. Dept. of Ec. Devel.	*4)	143,000	9/93 - 8/95	5%	1 month	University of Connecticut
	B2. DED	*5)	99,868	7/93 - 7/95	10%	1 month	University of Connecticut
	B3. DED	*6)	98,868	7/93 - 7/95	10%	1 month	University of Connecticut
	C4.						
	C5.						
III. Prior Support for this Project If this project has previously been funded.	1.	* 1) "Quantitative Comparison of Laser Induced Fluorescence and Molecular Spectroscopy in Combustion Systems"					
	2.	* 4) Development of High Performance Combustion Engine * 5) Experimental Study of Two-Phase Flow and Boiling heat Transfer on Spirally Fluted Pipes "					
IV. Other agencies to which this proposal has been/ will be submitted.	1.	* 6) "A Study of Mixing and Combustion in Pulsed - Combustion Furnaces "					
	2.						
	3.						

1. Include Federal and Other State Agencies, and private resources
2. Entry to project title should be number coding (i.e., 1, 2, ...) and the full titles should be identified according to number on an attached sheet (i.e., 1. full title, 2. full title ...)
3. Non-academic researchers may report percentage of total research effort using the first column only.

USE ADDITIONAL SHEETS AS NECESSARY

	YEAR I	YR I MATCH	YEAR II	YR II MATCH	DED TOTAL	MATCH TOTAL
1. SENIOR PERSONNEL CAL ACAD SUMR					0	0
1 R. G.	7,000		7,500		14,500	0
2 Z.B.	10,000		10,700		20,700	0
3 W.O.	6,500		7,000		13,500	0
4 B.C.	5,800		6,300		12,100	0
5			0		0	0
6 () Total Senior Personnel	29,300	0	31,500	0	60,800	0
1 Post Doctoral Associates			0		0	0
2 Other Professionals		12,000	0	13,080	0	25,080
3 Graduate Students	22,084		23,630		45,714	0
4 Undergraduate Students	2,500		2,750		5,250	0
5 Secretarial/Clerical			0		0	0
6 Other		24,000	0	13,080	0	37,080
TOTAL SALARIES AND WAGES	53,884	36,000	57,880	26,160	111,764	62,160
C. Fringe Benefits AA5	5,877	5,640	7,167	2,878	13,045	8,518
TOTAL SALARIES AND FRINGES	59,761	41,640	65,047	29,038	124,809	70,678
D. Stipend *					0	0
E. Level 1. Domestic	2,500	2,000	2,500	2,000	5,000	4,000
2. Foreign					0	0
F. Participant Support Costs					0	0
1. Stipends					0	0
2. Travel					0	0
3. Subsistence					0	0
4. Other					0	0
Total Participant Costs *	0	0	0	0	0	0
G. Other Direct Costs						
1. Materials and Supplies	3,356	5,000	1,753	5,792	5,109	10,792
2. Publication Costs			1,500		1,500	0
3. Consultant Services					0	0
4. Computer *				63,603	0	63,603
5. Subcontracts *					0	0
6. Other	2,000		3,000		5,000	0
Total Other Direct Costs	5,356	5,000	6,253	69,395	11,609	74,395
H. Total Direct Costs	67,617	48,640	73,800	100,433	141,418	149,073
I. Total Indirect Costs @ 22% & 44%	14,876	10,700	16,236	26,226	31,112	36,926
J. Total Direct & Indirect Costs	82,493	59,340	90,036	126,659	172,529	185,999

* Not subject to indirect costs

	YEAR I	RATE	FB TOT
Ser per	0	-	
1	7,000	0.08	560
2	10,000	0.08	800
3	6,500	0.08	520
4	5,800	0.08	464
5	0		0
	<u>29,300</u>		<u>2,344</u>
doc	0		0
Other prof	0		0
Grads	22,084	0.16	3,533
Undergrad	2,500		0
Sub, cler	0		0
Other	0		0
sub total	<u>53,884</u>		<u>5,877</u>
Totals	<u>59,761</u>		

YEAR II	RATE	FB TOT
0	-	
7,500	0.10	750
10,700	0.10	1,070
7,000	0.10	700
6,300	0.10	630
0		0
<u>31,500</u>		<u>3,150</u>
0		0
0		0
23,630	0.17	4,017
2,750		0
0		0
0		0
<u>57,880</u>		<u>7,167</u>
<u>65,047</u>		

DEPARTMENT OF THE TREASURY
INTERNAL REVENUE SERVICE
ANDOVER MA 05501

APPENDIX 11
DATE OF THIS NOTICE: 01-10-92
NUMBER OF THIS NOTICE: CP 575 A
EMPLOYER IDENTIFICATION NUMBER: 06-1332879
FORM: SS-4 TAX PERIOD: 12
0816502634 B

TESTEA ENGINE SYSTEM INC
% GEORGE TESTEA PRES
77-A LOOMIS DR
W HARTFORD CT 06107

FOR ASSISTANCE PLEASE
WRITE TO US AT:

INTERNAL REVENUE SERVICE
ANDOVER MA 05501

BE SURE TO ATTACH THE
BOTTOM PART OF NOTICE

OR YOU MAY CALL US AT:

1-800-829-1040

TAX FORMS YOU MUST FILE:

1120

NOTICE OF NEW EMPLOYER IDENTIFICATION NUMBER ASSIGNED

Thank you for your Form SS-4, Application for Employer Identification Number (EIN). The number assigned to you is shown above. It will be used to identify your business account, tax returns and documents, even if you don't have employees.

1. Keep a copy of the number in your permanent records.
2. Use your name and the number exactly as shown above on all Federal tax forms.
3. Use the number on all tax payments and tax-related correspondence or documents.

Using a variation of your name or number may result in delays or errors in posting payments to your account. It also could result in the assignment of more than one Employer Identification Number.

We have established the filing requirements and tax period shown above for your account based upon the information provided. If you need help to determine your required tax year, get publication 538, Accounting Periods and Methods, which is available at most IRS offices.

If you are required to make Federal tax deposits for employment taxes (Forms 941, 943, 940 or CT-1), excise taxes (Form 720), withholding tax (Form 1042), and/or income taxes (Form 1120), an initial supply of Federal tax deposit coupon books will be sent to you. Please allow 5 to 6 weeks for delivery.

Thank you for your cooperation.

APPENDIX III

CAD & CAM LABORATORY EQUIPMENT LIST

Item	How Many	Unit Cost	Date of Purchase
IRIS SGI 2400	3	\$ 20,000.-	1983
IRIS SGI 3130	1	\$ 60,000.-	1986
Personal IRIS	2	12,000.-	1990
SGI 4080S server	1	20,000.-	1990
Selec color printer	1	\$ 6,000.-	1990
Matrix 6000 Hard Copy	1	\$ 12,000.-	1986
H-800 Super Minicomput.	1	\$374,067.-	1985 (grant)
Tektronix 4225	1	\$ 8,000.-	1988
IBM PC	1	\$ 1,260.-	1984
Tektronix 4014 DVST	1	\$ 14,000.-	1976
HP 7550A 8 Pen Plotter	1	\$ 3,800.-	1985
Gerber Sc. Autograph Sys.	1	\$120,000.-	1986 (grant)
IBM Proprinter	1	\$ 300.-	1986
IBM PS II/50	2	\$ 4,800.-	1988
HP 7574 6 Pen Plotter	3	\$ 800.-	1989
HP Laser Jet II printer	1	\$ 1,200.-	1989
IBM PC AT	1	\$ 3,600.-	1986
Rolland CAMM - 3 Cutter	2	\$ 16,000.-	1989
CAMM-1 (build in the lab)	1	\$ 2,000.-	1986
CAMM-2 (build in the lab)	1	\$ 1,500.- (still under construct.)	



Testea
Engine Systems Inc.

APPENDIX VI

GEORGE TESTEA, President

November 24, 1992

Dr. Thomas Tighe
Provost
University of Connecticut
Storrs, Connecticut

Joint Project for the Development
of a New Very High Performance Rotary Internal Combustion Engine

Dear Dr. Tighe,

On behalf of Testea Engine Systems Inc., I am pleased to confirm that we endorse the statement of collaborative intent as outlined on pages 9 and 10 of this document. Ownership of any programs developed would be held jointly by the University and Testea Engine Systems Inc.

Testea Engine Systems Inc. recognizes the importance of collaboration with education and research institutions and in particular with the University of Connecticut.

Yours Sincerely,

George Testea

George Testea
President of Testea Engine Systems Inc.



Testea Engine Systems Inc.

APPENDIX V (

GEORGE TESTEA, President

November 24, 1992

Dr. Thomas Tighe
Provost
University of Connecticut
Storrs, Connecticut

Joint Project for the Development of a New Very High Performance Rotary Internal Combustion Engine

Dear Dr. Tighe,

Testea Engine Systems Inc. agrees to co-sponsor the attached proposal in the event that it is sponsored by the Connecticut Department of Higher Education. Our in-kind contribution will be no less than \$186,000.00 over a two year period. This will consist of consulting, materials and technical and shop assistance. We reserve the right to alter the proportions of each of these parts of our contribution.

Let me take this opportunity to compliment Dr. Bzymek on taking the initiative in developing this program and the associated sponsorship. Testea Engine Systems Inc. is a newly developed company which is promising a lot in the area of research and development of internal combustion engines. Thanks to the efforts of Dr. Bzymek, Dr. Cetegen, and Dr. Olgac a mutually beneficial relationship between the University and the company has been fostered. This will benefit not only the University and Testea Engines Inc., but also the State of Connecticut educationally, professionally and economically.

We look forward to a successful joint project.

Yours Sincerely,

George Testea
President of Testea Engine Systems Inc.

**THE UNIVERSITY OF CONNECTICUT
STATEMENT OF COLLABORATIVE POLICIES
November, 1992**

The Cooperative High Technology Research and Development Grant Program was established to encourage research and development between Connecticut business and industry and institutions of higher education. The program will improve the transfer of basic research results to practical applications, allow industrial and academic scientists to improve their skills and remain current with research and development trends in their disciplines, provide additional resources to enhance and expand academic research opportunities, and stimulate economic development in the state.

PUBLICATIONS

Publications which may result from collaborative research under this program would, in general, be joint publications between The University of Connecticut and the co-sponsor. The co-sponsor would have the right to review the publication prior to submission. Prearranged and specified periods of minimum delay in publication may be agreed upon to ensure an opportunity to evaluate the patentability and to prepare and file an application.

It is imperative that faculty and students continue to maintain the freedom to disseminate the results of research. Therefore, no agreements can be made by the University to censor or restrict final disclosure of research findings.

PROPRIETARY INFORMATION

Any information designated in writing as proprietary and disclosed by either party to the other will be considered confidential and will not be released to any other party without the written consent of the disclosing party.

PATENTS POLICY

The University's patent policy reflects its obligation to disseminate knowledge through publication as well as its obligation to serve the public interest by ensuring that inventions are developed to the point of maximum utilization and availability to the public.

COLLABORATIVE AGREEMENTS

The University of Connecticut will negotiate a research agreement with the co-sponsor after the project has been selected for an award. It is expected that the contract will reflect: the intent of this statement of collaborative policy; mutually satisfactory and equitable provisions relating to inventions, patents and licenses; and, Department of Higher Education regulations and requirements. Finally, it will be negotiated to reflect the needs of each individual project.

CONNECTICUT INNOVATIONS, INC.
CHARLES GOODYEAR COOPERATIVE RESEARCH
AND DEVELOPMENT GRANT PROGRAM

Proposal # and Title (First 5 words): 93G019 A Very High Prof...

REVIEW PANEL EVALUATION FORM

Please score the items using a scale of 1 (poor) to 5 (excellent). Some items have check-off responses. Use the comment sections to explain, clarify and support your ratings and responses. We ask that you not write your name on this form since we do make copies available to grant applicants upon request. Please use a pen or type your responses so that copies will be more legible.

1. The extent to which the project addresses the purposes of the program

a. Encourages cooperative research and development between industry and higher education

Comments: It certainly appears that the industry-academia link is strong here. Score 5

b. Advances high technology research in Connecticut

Comments: The project, if successful, would seem to open the door to innovative engine design in Ct. Score 5

c. Stimulates economic development in Connecticut

Comments: This would seem to be quite promising provided the system works. Score 5

2. Proposed project is appropriate and is adequate, explained
- o objectives
 - o relation to present state of knowledge in the field
 - o general plan of work
 - o description of experimental methods and procedures

Comments: The technical review makes

Score 3.5

same excellent points in regard to the conduct of the research.

3. Evidence of Commitment

- a. Institutional commitment to the area and to this specific project

Comments: I don't quite follow the statement

Score 4

on page 4 in regard to institutional commitment. Has release time been granted to the PIs?

- b. The role of the co-sponsor in the proposed project

Comments: The company owns the engine &

Score 4

presumably all of its specifications, & it is most likely that the company will actively participate. This, however, ought to be made much clearer.

- c. Competencies of proposed research staff

- o faculty investing sufficient time in project
- o level of involvement of faculty vs. graduate students

Comments: The 3.5 is not a comment on the

Score (3.5)

PIs present, who are clearly all good researchers.

I do wonder if the tech. reviewer's comments might have a point (about having an engine person involved).

- d. Adequacy of research facilities to support this project

Comments:

Score 5

But this is not a drawback of any real severity in my mind. All 4 of the PIs together bring a great synergy to the project.

c. Involvement of small business

yes ☒

no ☐

Comments:

d. Evidence that the project will continue after grant period

yes ☐

no ☒

Comments: — none written, but I imagine that it would continue.

6. Potential for project to generate additional funding or support

Comments: I am unsure of this.

Score 4

7. The intrinsic merit of proposed project

Comments:

I can't really liking this project
I think CT. is the ideal place to get going
on an idea like this. If this takes off, it could be
the beginning of a significant industry in a state which
Does this project merit funding? is well prepared to supply
a workforce for it.
yes ☒ no ☐ possibly ☐

Comments:

Score 5

YANKEE INGENUITY INITIATIVE

CHARLES GOODYEAR COOPERATIVE RESEARCH & DEVELOPMENT GRANTS

TECHNICAL REVIEWER EVALUATION FORM

Proposal Number: 939019

Proposal Title: Very High Performance Multi-Rotor Internal Combustion Engine

Reviewer:

Please complete each section below in ink or typed. Rank the proposal on each of the criteria with a score between (1) poor to (5) outstanding. Be conservative in scoring and use scores of five only in extraordinary circumstances. Continue comments on additional pages if necessary.

1. Scientific merit of proposal

Score 4

Comments:

A simple engine with low fuel consumption has an excellent future in either large or small engines. Before that can really be determined it is very important that actual test experience be gained. Even a very simple version should be built and run early in the program.

2. Appropriateness and feasibility of proposed research methods

Score 3

Comments:

See comment in 1.

The program as planned depends heavily on analytical studies of various aspects of the engine. No tests of actual hardware are run until the final phase of the project. This is too late. In the first phase, a very simple but representative model should be built and run in both cold air and hot gas tests to see how the systems behave. Much valuable data would become available to influence the design. I note that none of the research group cites actual experience in experimental development of

3. Relationship to the improvement of high technology instruction or research

Score 4

Comments:

If the program is revised to begin simple but important tests of heat paths, frictional values, leakage paths, heat flows and part tolerances required for performance the program could provide an excellent experience in design methods and ways to gain insight into the actual mechanisms of gas flow, heat transfer, etc. This is the best way to teach design - a combination of analysis and relevant test data.

4. Potential for promoting high technology development

Score 95

Comments:

A myriad of small engines and natural gas engines of various sizes as well as automobiles could be influenced by the simplicity of this engine provided it shows by data, its potential and its ability to be rapidly developed further.

5. Qualifications of researchers

Score 4

Comments:

The researchers are well qualified in their fields. However, as pointed out in 2 and 3 an experimentally oriented engineer needs to be added and test data obtained early in the program so that the real design is based on both representative data of the key areas such as gas leakage and part expansion under hot and cold conditions and analytical design using the experimental data results to guide the design. A design program of this type has a much better chance of being successful than the current one.

OVERALL ASSESSMENT:

Does this proposal merit the Connecticut Innovations, Inc. funding?

Yes X No Possibly

Comments:

See comments

ADDITIONAL COMMENTS:

Please return by February ¹⁵~~28~~ to: Nancy Rion, Director, Yankee Ingenuity Initiative,
Connecticut Innovations, Inc., 845 Brook Street, Building #2, Rocky Hill, CT 06067
Phone: (203) 258-4305 FAX: (203) 563-4877

LAW OFFICE OF
IRA S. DORMAN
WATKINS CENTRE
985 MAIN STREET
MANCHESTER, CONNECTICUT 06040

TELEPHONE (203) 649-1666
TELECOPIER (203) 643-6930

April 16, 1993

Mr. George Testea
77A Loomis Drive
West Hartford, Connecticut 06107

United States Patent Application for
ROTARY ENGINE SYSTEM - Our File: TES-1

Dear Mr. Testea:

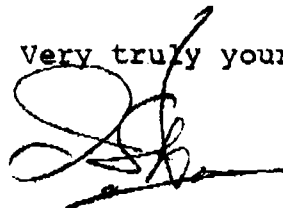
Enclosed are copies of Notices of Allowability and of Allowance in connection with the captioned application. In view of this action, a United States patent will issue to you, containing all 14 claims originally filed (as amended), upon payment of the required issue fee (\$585).

In addition to that amount, we normally obtain copies of the patent for the client, the minimum order being ten, at \$3 each. There is also a charge of \$150 for our services in finalization of the application.

Accordingly, upon receipt of your check in the amount of \$1,495.37 (which includes the balance of \$730.37 that is outstanding in your account), we will pay the necessary fees and bring the patent to issue. We normally wait to make payment until near the end of the allotted time (which expires on July 6, 1993 in this instance), since doing so will cause the patent to expire as far as possible into the future. However, if you prefer that the fee be paid sooner we will of course comply with your wishes.

Please contact us if you have questions in regard to the matter.

Very truly yours,



ISD:slc
Enclosures



**UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office**

Address: Box ISSUE FEE
COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

IRA S. DORMAN
WATKINS CENTRE
935 MAIN STREET
MANCHESTER, CT 06040

34M1

**NOTICE OF ALLOWANCE
AND ISSUE FEE DUE**

✓ Note attached communication from the Examiner
This notice is issued in view of applicant's communication filed

SERIES CODE/SERIAL NO	FILING DATE	TOTAL CLAIMS	EXAMINER AND GROUP ART UNIT	DATE MAILED
07/811,538	12/20/91	014	KOCZO JR, M	3403 04/05/93
First Named Applicant	TESTEA, GEORGE			
TITLE OF INVENTION	ROTARY ENGINE SYSTEM			

ATTY'S DOCKET NO.	CLASS-SUBCLASS	BATCH NO.	APPLN. TYPE	SMALL ENTITY	FEE DUE	DATE DUE
3 TES-1	123-235.000	136	UTILITY	YES	\$585.00	07/06/93

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED.

THE ISSUE FEE MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED, THIS STATUTORY PERIOD CANNOT BE EXTENDED.

HOW TO RESPOND TO THIS NOTICE:

I. Review the SMALL ENTITY Status shown above.

If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:

- If the Status is changed, pay twice the amount of the FEE DUE shown above and notify the Patent and Trademark Office of the change in status, or
- If the Status is the same, pay the FEE DUE shown above.

If the SMALL ENTITY is shown as NO:

- Pay FEE DUE shown above, or
- File verified statement of Small Entity Status before, or with, payment of 1/2 the FEE DUE shown above.

II. Part B of this notice should be completed and returned to the Patent and Trademark Office (PTO) with your ISSUE FEE. Even if the ISSUE FEE has already been paid by a charge to deposit account, Part B should be completed and returned. If you are charging the ISSUE FEE to your deposit account, Part C of this notice should also be completed and returned.

III. All communications regarding this application must give series code (or filing date), serial number and batch number. Please direct all communications prior to issuance to Box ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees.

REPRODUCED FROM
BEST AVAILABLE COPY



UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office
Address: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

SERIAL NUMBER	FILING DATE	FIRST NAMED APPLICANT	ATTORNEY DOCKET NO.
---------------	-------------	-----------------------	---------------------

07/21/91 12/20/91 TESTED

TEB-1
EXAMINER

IRA S. DORMAN
WATKINS CENTRE
335 MAIN STREET
MANCHESTER, CT 06040

04M1

04M1

ART UNIT PAPER NUMBER

DATE MAILED 04/05/93

NOTICE OF ALLOWABILITY

PART I

- ☒ This communication is responsive to Examiner's Interview Summary Record, PTO-413
- ☒ An the claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance And (Issue Fee Due or other appropriate communication will be sent in due course.
- ☒ The allowed claims are 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100
- ☒ The drawings filed on 2/1/91 are acceptable.
- ☐ Acknowledgment is made of the claim for priority under 35 U.S.C. 119. The certified copy has ☐ been retained. ☐ not been received. ☐ See M. Patent Application Serial No. 07/000,000, filed on 07/21/91.
- ☐ Note the attached Examiner's Amendment.
- ☐ Note the attached Examiner Interview Summary Record, PTO-413.
- ☐ Note the attached Examiner's Statement of Reasons for Allowance.
- ☐ Note the attached NOTICE OF REFERENCES CITED, PTO-892.
- ☐ Note the attached INFORMATION DISCLOSURE CITATION, PTO-749.

PART II

A SHORTENED STATUTORY PERIOD FOR RESPONSE TO comply with the requirements noted below is set to EXPIRE THREE MONTHS FROM THE "DATE MAILED" indicated on this form. Failure to timely comply will result in the ABANDONMENT of the application. Extensions of time may be obtained under the provisions of 37 C.F.R. 1.136(a) or 1.136(b).

- ☐ Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL APPLICATION, PTO-152, which describes that the oath or declaration is deficient. A SUBSTITUTE OATH OR DECLARATION IS REQUIRED.
- ☐ APPLICANT MUST MAKE THE DRAWING CHANGES INDICATED BELOW IN THE MANNER SET FORTH ON THE REVERSE SIDE OF THIS PAPER.
 - ☐ Drawing formalities are indicated on the NOTICE RE PATENT DRAWINGS, PTO-948, attached hereto to (to Paper No. 07/000,000). CORRECTION IS REQUIRED.
 - ☐ The proposed drawing correction filed on 02/1/92 has been approved by the examiner. CORRECTION IS REQUIRED.
 - ☐ Approved drawing corrections are described by the examiner in the attached EXAMINER'S AMENDMENT. CORRECTION IS REQUIRED.

